

- 1 1. A method of producing an oriented oxide superconducting film, comprising:
 - 2 (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film
 - 3 comprising the constituent metallic elements of an oxide superconductor
 - 4 in substantially stoichiometric proportions;
 - 5 (b) initiating conversion of the metal oxyfluoride into the oxide superconductor in
 - 6 a processing gas having a moisture content of less than 1% by mass and a
 - 7 total pressure less than atmospheric pressure for a time sufficient to form a
 - 8 layer of the oxide superconductor at the substrate/film interface; and
 - 9 (c) completing conversion of the metal oxyfluoride into the oxide superconductor
 - 10 in a processing gas having a moisture content greater than that in step (b)
 - 11 and a total pressure less than atmospheric pressure.
- 12 2. The method of claim 1, wherein the moisture content in step (c) is between 4.5
- 13 and 35% by mass.
- 14 3. The method of claim 1, wherein the PH_2O during step (b) is less than 10 mTorr
- 15 and the total pressure is about 8 Torr or less.
- 16 4. The method of claim 1, wherein the PH_2O during step (c) is between 150 and 350
- 17 mTorr and the total pressure is about 8 Torr or less
- 18 5. The method of claim 1, wherein the total pressure is less than about 8 Torr.
- 19 6. The method of claim 5, wherein the total pressure is less than about 1 Torr.
- 20 7. The method of claim 1, wherein the total pressure is less than about 0.1 Torr.
- 21 8. The method of claim 1, wherein the processing gas consists substantially of water
- 22 vapor and oxygen.
- 23 9. The method of claim 1, further comprising depositing a buffer layer on the
- 24 substrate before the step of depositing.

- 1 10. The method of claim 9, wherein the buffer layer comprises a member of yttria-
2 stabilized zirconia, LaAlO_3 , SrTiO_3 , CeO_2 , Y_2O_3 , and MgO and any combination
3 of the above.
- 4 11. The method of claim 1, wherein the film has a thickness of at least $0.3\mu\text{m}$.
- 5 12. The method of claim 11, wherein the film has a thickness of at least $0.5\mu\text{m}$.
- 6 13. The method of claim 12, wherein the film has a thickness of at least $0.8\mu\text{m}$.
- 7 14. The method of claim 13, wherein the film has a thickness of at least $1\mu\text{m}$.
- 8 15. The method of claim 1, wherein the superconductor comprises YBCO.
- 9 16. The method of claim 1, wherein the substrate comprises a ceramic.
- 10 17. The method of claim 16, wherein the ceramic is selected from the group
11 consisting of YSZ, LaAlO_3 , SrTiO_3 , CeO_2 , and MgO .
- 12 18. The method of claim 1, wherein the substrate comprises a metal having a texture
13 selected from untextured, uniaxial texturing, and biaxial texturing.
- 14 19. The method of claim 18, wherein the metal is selected from steel, nickel, iron,
15 molybdenum, copper, silver, and alloys and mixtures thereof.
- 16 20. A c-axis textured superconducting film fabricated by the steps of
17 (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film
18 comprising the constituent metallic elements of an oxide superconductor
19 in substantially stoichiometric proportions;
20 (b) initiating conversion of the metal oxyfluoride into the oxide superconductor in
21 a processing gas having a moisture content of less than 5% by mass and a
22 total pressure less than atmospheric pressure for a time sufficient to form a
23 layer of the oxide superconductor at the substrate/film interface; and

- 1 (c) completing conversion of the metal oxyfluoride into the oxide superconductor
2 in a processing gas having a moisture content greater than that in step (b)
3 and a total pressure less than atmospheric pressure.
- 4 21. The c-axis textured superconducting film of claim 20, wherein the texture is
5 biaxial.
- 6 22. The c-axis textured superconducting film of claim 20, wherein the film has a J_c
7 greater than 0.45 MA/cm^2 .
- 8 23. The c-axis textured superconducting film of claim 22, wherein the film has a J_c
9 greater than 1 MA/cm^2 .
- 10 24. The c-axis textured superconducting film of claim 23, wherein the film has a J_c
11 greater than 2 MA/cm^2 .
- 12 25. The c-axis textured superconducting film of claim 24, wherein the film has a J_c
13 greater than 4 MA/cm^2 .
- 14 26. The c-axis textured superconducting film of claim 20, wherein the moisture
15 content in step (c) is between 4.5 and 34%.
- 16 27. The c-axis textured superconducting film of claim 20, wherein the PH_2O during
17 step (b) is less than 10 mTorr and the total pressure is about 8 Torr or less.
- 18 28. The c-axis textured superconducting film of claim 20, wherein the PH_2O during
19 step (c) is between 150 and 350 mTorr and the total pressure is about 8 Torr or
20 less.
- 21 29. The c-axis textured superconducting film of claim 20, wherein the total pressure
22 is less than about 8 Torr.
- 23 30. The c-axis textured superconducting film of claim 20, wherein the processing gas
24 consists substantially of water vapor and oxygen.

- 1 31. The c-axis textured superconducting film of claim 20, wherein the substrate
2 comprises a base and a buffer layer interposed between the base and the
3 superconducting film.
- 4 32. The c-axis textured superconducting film of claim 31, wherein the buffer layer
5 comprises a member of ceria, yttria-stabilized zirconia, yttrium oxide, and any
6 combination of the above.
- 7 33. The c-axis textured superconducting film of claim 20, wherein the film has a
8 thickness of at least 0.5 μ m.
- 9 34. The c-axis textured superconducting film of claim 33, wherein the film has a
10 thickness of at least 1 μ m.
- 11 35. The c-axis textured superconducting film of claim 20, wherein the superconductor
12 comprises YBCO.
- 13 36. The c-axis textured superconducting film of claim 20, wherein the substrate
14 comprises a ceramic.
- 15 37. The c-axis textured superconducting film of claim 36, wherein the ceramic is
16 selected from the group consisting of YSZ, LaAlO₃, SrTiO₃, CeO₂, and MgO.
- 17 38. The c-axis textured superconducting film of claim 20, wherein the substrate
18 comprises a metal.
- 19 39. The c-axis textured superconducting film of claim 38, wherein the metal is
20 selected from steel, nickel, iron, molybdenum, copper, silver, and alloys and
21 mixtures thereof.
- 22 40. A method of producing an oriented oxide superconducting film, comprising:
23 (a) providing a metal oxyfluoride film on a substrate, said metal oxyfluoride film
24 comprising the constituent metallic elements of an oxide superconductor
25 in substantially stoichiometric proportions;

- 1 (b) converting the metal oxyfluoride into the oxide superconductor in a processing
2 gas having a total pressure less than atmospheric pressure.
- 3 41. The method of claim 40, wherein the total pressure is less than about 8 Torr.
- 4 42. The method of claim 41, wherein the total pressure is less than about 1 Torr.
- 5 43. The method of claim 42, wherein the total pressure is less than about 0.1 Torr.
- 6 44. The method of claim 43, wherein the total pressure is less than about 0.01 Torr.
- 7 45. The method of claim 44, wherein the total pressure is less than about 0.01 Torr.
- 8 46. The method of claim 45, wherein the total pressure is less than about 0.001 Torr.
- 9 47. The method of claim 40, wherein the processing gas consists substantially of
10 water vapor and oxygen.
- 11 48. The method of claim 40, further comprising depositing a buffer layer on the
12 substrate before the step of depositing.
- 13 49. The method of claim 48, wherein the buffer layer comprises a member of yttria-
14 stabilized zirconia, LaAlO_3 , SrTiO_3 , CeO_2 , Y_2O_3 , and MgO and any combination
15 of the above.
- 16 50. The method of claim 40, wherein the film has a thickness of at least $0.3\mu\text{m}$.
- 17 51. The method of claim 50, wherein the film has a thickness of at least $0.5\mu\text{m}$.
- 18 52. The method of claim 51, wherein the film has a thickness of at least $0.8\mu\text{m}$.
- 19 53. The method of claim 52, wherein the film has a thickness of at least $1\mu\text{m}$.
- 20 54. The method of claim 40, wherein the superconductor comprises YBCO.
- 21 55. The method of claim 40, wherein the substrate comprises a ceramic.

- 1 56. The method of claim 55, wherein the ceramic is selected from the group
2 consisting of YSZ, LaAlO₃, SrTiO₃, CeO₂, and MgO.
- 3 57. The method of claim 40, wherein the substrate comprises a metal having a texture
4 selected from untextured, uniaxial texturing, and biaxial texturing.
- 5 58. The method of claim 57, wherein the metal is selected from steel, nickel, iron,
6 molybdenum, copper, silver, and alloys and mixtures thereof.
- 7 59. The method of claim 40, wherein the film has a J_c greater than 0.45 MA/cm².
- 8 60. The method of claim 59, wherein the film has a J_c greater than 1 MA/cm².
- 9 61. The method of claim 60, wherein the film has a J_c greater than 2 MA/cm².
- 10 62. The method of claim 61, wherein the film has a J_c greater than 4 MA/cm².